gross anatomical investigation, minute histological examination, and experimental inquiry were, in a striking manner, made to assist each other, Dr. Gaskell, by tracing out the course and determining the nature of vaso-constrictor and vaso-dilator fibres, and comparing them with the cardiac augmentor and inhibitory fibres, and with the fibres governing the visceral muscles, has already reduced to order what previously was to a large extent confusion, and has opened up what promises to be the way to a complete understanding of the whole subject.

The results arrived at, besides their great physiological importance, on the one hand promise to be of great assistance in practical medicine, and on the other are eminently suggestive from a purely morphological point of view.

The other Royal Medal has been awarded to Prof. Thomas Edward Thorpe for his researches on fluorine compounds, and his determination of the atomic weights of titanium and gold.

Prof. Thomas Edward Thorpe's experimental work has secured for him a place in the first rank of living experimentalists.

His researches, which are not confined to one department of chemical science, but extend over many branches, are all distinguished both by accuracy and originality of treatment. As examples of the high character of his investigations, those of the determinations of the atomic weights of titanium and gold may be specially cited as permanently settling the value of two most important chemical constants; whilst his researches on the fluorine compounds, including the discovery of thiophosphoryl fluoride, a body capable of existing undecomposed in the state of gas, and his latest work on the vapour-density of hydrofluoric acid, do not fall short of the highest examples of classical chemical investigation.

The Davy Medal has been awarded to Dr. W. H. Perkin for his researches on magnetic rotation in relation to chemical constitution.

Dr. Perkin is well known as the originator of what is now a great industry, that of the coal-tar colours, by his preparation and application to tinctorial purposes of a colouring matter which had previously merely been noticed as affording a chemical test for the presence of aniline. This, however, is now a long time ago, and it is for more recent work, the interest of which is purely scientific, that the medal has been awarded to him.

Dr. Perkin first showed, in 1884, that a definite relationship exists between the chemical constitution of substances and their power of rotating the plane of polarization of light when under magnetic influence; and he pointed out how the "molecular coefficient of magnetic rotation" or "molecular rotatory power" might be deduced.

In 1884 he presented to the Chemical Society a lengthy paper describing his method, and the results obtained for a very large number of paraffinoid hydrocarbons and haloid and oxygenated derivatives thereof; from these he deduced "constants," which he has since shown to be applicable in calculating the magnetic rotatory power of paraffinoid compounds generally. From time to time he has published further instalments of his work, and only quite recently has described the results obtained on examining nitrogen compounds, which exhibit many most interesting peculiarities.

The results are of special value on account of the exceptional care devoted to the preparation of pure substances, and the guarantee, which Dr. Perkin's reputation affords, that everything possible has been done to secure accuracy; and also because the substances chosen are for the most part typical substances, or belong to series in which a simple relationship exists.

HAIL-STORMS IN NORTHERN INDIA.

In a paper recently published in the Journal of the Asiatic Society of Bengal, Mr. S. A. Hill describes certain severe hail-storms and tornadoes that occurred on April 30 and May 1, 1888, in the Gangetic *doab* and Rohilkand in Northern India.[1] Tornadoes are not very common in India, but they appear to have been somewhat more prevalent than usual in the spring of 1888, the storms in question having been preceded on April 7 by a very destructive tornado at Dacca in Bengal, a full description of which was given by Mr. Pedler and Dr. Crombie in a previous number of the Society's Journal. Like all previously recorded storms of this character, these occurred in the spring, when the seat of minimum pressure is established in the Lower Punjab, and a trough of low pressure extends from this region eastward to the Gangetic plain. To the south of this trough very dry west winds, the hot winds of Northern India, prevailed in Rajputana and Central India, while, to the north of it, damp easterly winds blew up the northern margin of the plain and across the outer slopes of the Himalaya. It is apparently in the meeting of these two winds, where the former blows in an upper, the latter in the lower, stratum, that are generated the thunder squalls that form a normal feature of the spring months in Northern India; and tornadoes, as Prof. Ferrel has shown, are merely an exaggerated development of the thunder squall. In the present instance, ordinary storms of this character, and dust storms, occurred pretty generally over all the north-western districts of the North-West Provinces, simultaneously with the tornadoes in Rohilkand and the Gangetic *doab*.

From the evidence quoted by Mr. Hill, it does not appear indeed to be positively established that any of the storms described exhibited all the characteristic features of tornadoes, as was undoubtedly the case of the Dacca storm. No mention is made in any of the reports of any whirling column having been actually observed; and that whirlwinds were the real agents of destruction seems to be inferred chiefly from the destructive force of the wind, especially its lifting power, and some rather vague reports on the wind's changes during the passage of the storm. On a point of this kind, however, in India, negative evidence goes for little, and the chief subject discussed in Mr. Hill's paper, viz. the conditions which determine these atmospheric disturbances, is of equal interest, whether they were really tornadoes or only remarkably severe hail-storms of the more usual kind.

In the barometric changes of the days preceding the storms there does not appear to be anything that throws much light on their genesis. The relative distribution of pressure shown by the observations on the Indo-Gangetic plain underwent but little variation, and the existence of a slight secondary depression in the immediate neighbourhood of the storm tract, on April 30, is inferred solely on the evidence of two Himalayan stations at elevations of 5300 feet and 6000 feet above the sea, and may be delusive. There had, however, been a general steady fall of the barometer for three days before the storms of April 30—one of those oscillations, apparently, which Mr. Abercromby has termed surges, and a rapid rise set in after the storms. As has been pointed out elsewhere, this is an ordinary recurrent feature of the season.

It is in the changes in the vertical distribution of temperature that Mr. Hill finds the conditions that determined the atmospheric disturbance. Taking as his fundamental data the observed temperatures of the three stations, Roorkee at 886 feet, Dehra at 2233 feet, and Mussooree at 6881 feet, and assuming that these represent approximately the rate of vertical decrease over the neighbouring plain, he computes the fall of temperature for increments of 1000 feet up to 10,000 feet by means of a simple formula of interpolation, and finds that, up to the forenoon of April 30, the condition of unstable equilibrium which results from the diurnal heating of the plains did not extend beyond 3000 or 4000 feet above the ground surface. This would set up a considerable amount of convective interchange between these lower strata, but the cloud-forming strata would still be in a stable condition, at least in a non-saturated atmosphere. On the afternoon of April 30, the conditions were changed. With a great fall of temperature at the lowest and highest stations, as compared with the previous day at the same hour, that of the intermediate station was but little affected, and hence the computed table shows a reduction of the vertical decrement at low levels, a corresponding increase at the higher levels, and a transfer of the condition of unstable equilibrium from the former to the latter. Simultaneously with this change took place that violent disturbance of the atmosphere that resulted in the hail-storms on the plains.

Mr. Hill's conclusions are entirely in accord with what might be expected on *a priori* grounds. But before they can be fully accepted, it is necessary to scrutinize the data, and as the result of this scrutiny we must confess they do not seem to us completely convincing. We may put aside the question whether and to what extent the empirical formula of interpolation adopted by Mr. Hill really expresses the law of decrement of temperature, since, although it would evidently fail for extrapolation much beyond the altitude of 7000 feet, it probably does not involve any very serious error below that limit, provided the numerical values afforded by observation are trustworthy. The

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[1] *Op. cit.*, vol. lviii., Part 2, No 2, 1889.

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critical point of the whole reasoning is whether the observed temperatures at the three stations Roorkee, Dehra, and Mussooree, can be safely accepted as approximately representing those of the free atmosphere over the plains at the same levels, and this seems to us at least open to question. In the case of the lowest and highest stations, indeed, there is not much to object to. Roorkee is a fairly representative station of the northern part of the Gangetic plain, and the Mussooree Observatory, situated on the very crest of the ridge of the Himalaya, overlooking the plains, is probably as little affected by the local heating of the ground as any mountain observatory can be. But Dehra, which furnishes the really critical datum of Mr. Hill's reasoning, is on the plain of the *Dún*, a flat valley six or eight miles across, stretching between the Sivaliks and the foot of the Mussooree ridge, and it is by no means self-evident that the local temperature is not largely affected by causes which are quite inoperative in the free atmosphere at the same elevation over the plains.

In our opinion, then, Mr. Hill's conclusion that the storms of April 30 and May 1 were determined by a change in the vertical distribution of temperature, transferring the condition of instability from the lower to the higher atmospheric strata, is at least open to doubt. To a certain extent, indeed, it is supported by the evidence of other observatories in the North-West Himalaya, especially Chakrata, the situation of which is very similar to that of Mussooree; but the difference of their elevation (170 feet) is too small to allow of its having much weight in determining the point at issue.

The most noteworthy feature of the storm of April 30 was the fearful loss of life caused by it at Moradabad. Not less than 230 deaths were reported at this station alone, the vast majority of which were caused directly by the hail. The collector's report states that men caught in the open and without shelter were simply pounded to death. The spring is especially the season of native weddings, and "more than one marriage party was caught by the storm near the banks of the river and was annihilated." It is, however, suggested by Mr. Hill that many of the deaths may have been caused by cold. "Immediately before the storm the temperature had been very high, and many if not the majority of the deaths due to it may have been occasioned by the persons exposed to its fury being knocked down and temporarily packed in ice." At Moradabad the hailstones are stated to have been the size of plums—probably the *bér* plum, *Zizyphus jujuba*, the cultivated form of which is two or three times as large as a walnut.

In the storm of May 1, the hailstones at some places were larger, though the destruction was less. At Ghaziabad they are said to have been as large as cricket balls, and one was picked up at Delhi weighing 4½ ounces. At Tilhar they are reported to have been larger than goose eggs, and at a neighbouring place they averaged 3 inches in diameter. Their form is described as a flat oval.

SCIENTIFIC SERIALS.

Bulletin de l'Académie Royale de Belgique, November 1889.—On the existence of a gizzard, and on its structure, in the family of the Scolopendridæ, by M. Victor Willem. The presence of a gizzard in the lower organisms was first determined by M. F. Plateau in 1876. But the gizzard of insects was long supposed to be merely a triturating organ acting mechanically, without any physiological function. Continuing Plateau's researches, M. Willem now finds that the gizzard is not only present in several genera of the Scolopendrid family, but that it is a true digester. The structure is fully described, and illustrated by two plates, on which are figured the gizzards of *Scolopendra hispanica*, *S. cingulata*, *S. heros*, *Scolopocryptops*, *Cryptops punctatus*, and *C. hortensis*. In these last, the apparatus is most highly developed, being even more complicated than amongst the higher order of insects. No explanation is offered of this apparent anomaly.—Unexpected proof of diurnal nutation, and necessity of taking it into consideration in the reduction of observations, by M. F. Folie. The coefficient of diurnal nutation as already approximately determined at 0·01s. by the author's numerous researches, has recently been confirmed in a somewhat remarkable manner by the results of M. Kobold's observations of the Polar star with the meridian circle of Strassburg. The azimuthal errors of this instrument were found to present, not an annual, but a diurnal period, and Kobold's corrections are shown to be illusory, being due to his neglect of the element of diurnal nutation in the reduction of his observations. When this element is taken into account, the results harmonize with those previously arrived at by M. Folie.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, Dec. 19, 1889.—"On the Effects of Pressure on the Magnetization of Cobalt." By C. Chree, M.A., Fellow of King's College, Cambridge. Communicated by Prof. J. J. Thomson, F.R.S.

It has long been known, from the classic researches of Dr. Joule, that a rod of iron free from stress increases in length when magnetized in a comparatively weak field. When, however, the strength of the field is continually raised, it has been found by Mr. Shelford Bidwell that the rod ceases to increase in length, and then shortens, so that in a sufficiently strong field the length becomes less than it was originally. It has also been found by Villari, Sir W. Thomson, and others, that when a rod of iron is exposed to successive loadings and unloadings of a given weight in a magnetic field, there appears a corresponding cyclic change of magnetization. In this cyclic change the maximum magnetization occurs when the load is "on," or when the load is "off," according as the field is weaker or stronger than a certain critical field depending on the load, called by Sir W. Thomson the Villari critical field.

Cobalt has been found by Mr. Shelford Bidwell to shorten when magnetized in weak fields, but to lengthen in very strong fields. The field in which it ceases to shorten is very much higher than the field in which iron ceases to lengthen. Also in weak fields Sir W. Thomson has found the magnetization of a cobalt rod under cyclic applications of tension to be least when the tension is "on."

Now, Prof. J. J. Thomson has shown that on dynamical principles the effect of changes of magnetization on the length of a rod of magnetic metal, and the effect of changes in the length of the rod on the magnetization, must be fundamentally connected. In his "Applications of Dynamics to Physics and Chemistry," he has arrived at mathematical equations connecting the two phenomena, such that from a knowledge of the one set of phenomena the character of the other set can be deduced.

The conclusions derived from the theory are in the case of iron in accordance with the results of experiment, at least in their general character. In cobalt there is also an agreement between theory and experiment, so far as Sir W. Thomson's experiments go. In the absence of further experiments it would, however, be impossible to tell whether or not this agreement extended to the strong fields in which occurred the important phenomena observed by Mr. Shelford Bidwell. The application of Prof. J. J. Thomson's formulæ to Mr. Shelford Bidwell's results led him to the conclusion that under cyclic applications of pressure a cobalt rod should experience cyclic change of magnetization, and that the maximum magnetization should answer to pressure "on," or to pressure "off," according as the magnetic field was weaker or stronger than a critical field, corresponding to the Villari field in iron. It was for the purpose of determining whether such a critical field did actually exist that the present investigation was commenced at Prof. J. J. Thomson's suggestion.

Employing the magnetometric method, it was found that the agreement between theory and experiment was at least as satisfactory in cobalt as in iron. The application of pressure-cycles in a magnetic field led to a cyclic change of magnetization in a cobalt rod, in which the maximum magnetization occurred when pressure was "on," or when it was "off," according as the strength of the field was below or above 120 C.G.S. units. This accordingly was the Villari critical field foreshadowed by theory.

In weak fields the first pressure applied after the introduction of the cobalt rod into the magnetizing coil caused a large increase in the induced magnetization. As the strength of the field was raised, this change in the magnetization attained a maximum, then, diminishing, vanished in a field considerably stronger than the Villari field for the cyclic effect, and in all stronger fields consisted in a diminution of magnetization.

Both Villari and Prof. Ewing observed that, after the break of the magnetizing current, cyclic changes of tension produced

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